CLAIMS

What is Claimed is:

1. A microelectronic contact structure, comprising:

a plurality of column elements, wherein each of said plurality of column elements has a top and a base, and wherein said bases are positioned for attachment to a substrate; and

a contact element joined to each of said column elements.

2. The microelectronic contact structure of Claim 1, wherein said contact element further comprises a beam formed of a resilient material.

3. The microelectronic contact structure of Claim 1, wherein said contact element further comprises a contact pad joined to each of said column elements adjacent to said tops thereof.

4. The microelectronic contact structure of Claim 1, wherein said column elements are substantially straight and parallel to one another.

5. The microelectronic contact structure of Claim 12, wherein said beam is positioned transverse to each of said plurality of column elements and joined to each of said column elements adjacent to said tops thereof.

6. The microelectronic contact structure of Claim 1, wherein said column elements are inclined to said contact element at an angle between 70° and 110°.

7. The microelectronic contact structure of Claim 1, wherein said column elements are perpendicular to said contact element.

8. The microelectronic contact structure of Claim 1, wherein each of said column elements is substantially cylindrical.

9. The microelectronic contact structure of Claim 2, wherein said beam is sloped away from said top of said column elements.

10. The microelectronic contact structure of Claim 2, further comprising a sacrificial substrate joined to said beam.

11. The microelectronic contact structure of Claim 2, wherein said beam is contoured.

12. The microelectronic contact structure of Claim 1, wherein each of said column elements comprises a segment of wire.

13. The microelectronic contact structure of Claim 2, wherein said beam is fabricated by a lithographic process that includes depositing said resilient material on a sacrificial substrate.

14. The microelectronic contact structure of Claim 2, further comprising a tip structure positioned on a surface of said beam opposite to said group of column elements.

15. The microelectronic contact structure of Claim 14, wherein said tip structure is positioned over said group of column elements.

16. The microelectronic contact structure of Claim 15, further comprising a substrate joined to each of said column elements at said base thereof, wherein said plurality of column elements are arranged in a group and configured such that said top of each of said column elements will deflect towards said substrate when a force towards said substrate is applied to said tip, whereby said microelectronic contact structure is resilient.

17. The microelectronic contact structure of Claim 16, wherein said beam has a free end cantilevered from said group of column elements.

18. The microelectronic contact structure of Claim 17, further comprising a tip structure positioned on said beam between said free end of said beam and said group of column elements.

19. The microelectronic contact structure of Claim 18, wherein said tip structure is positioned on a surface of said beam opposite to said group of column elements.

20. The microelectronic contact structure of Claim 18, wherein said tip structure is positioned adjacent to said free end of said beam.

21. The microelectronic contact structure of Claim 18, wherein said tip structure comprises a stand-off mounted to said beam, and a contact tip mounted to said stand-off.

22. The microelectronic contact structure of Claim 1, wherein each of said column elements comprises a wire core enclosed in a shell comprising at least one shell material.

23. The microelectronic contact structure of Claim 22, wherein said wire cores are comprised of a material less rigid than said at least one shell material.

24. The microelectronic contact structure of Claim 22, wherein said wire cores are comprised of a material more rigid than said at least one shell material.

25. The microelectronic contact structure of Claim 22, wherein said wire cores are comprised of a material selected from the group consisting of gold, copper, aluminum, and alloys thereof.

26. The microelectronic contact structure of Claim 22, wherein said shell is formed by plating said shell material onto said wire cores.

27. The microelectronic contact structure of Claim 22, wherein said at least one shell material is selected from the group consisting of nickel, tin, iron, cobalt, copper, silver, gold, platinum, tungsten, molybdenum, and alloys thereof.

28. The microelectronic contact structure of Claim 22, wherein said wire cores have a diameter less than a thickness of said shells.

29. The microelectronic contact structure of Claim 22, wherein said wire cores have a diameter greater than a thickness of said shells.

30. The microelectronic contact structure of Claim 1, further comprising said substrate joined to each of said column elements at said base thereof.

31. The microelectronic contact structure of Claim 2, further comprising said substrate joined to each of said column elements at said base thereof, and wherein said beam has a free end cantilevered from said group of column elements.

32. The microelectronic contact structure of Claim 31, wherein said microelectronic spring structure is configured such that said top of each of said column elements is substantially fixed while said free end of said beam will deflect under a force applied to said beam at said free end in a direction transverse to said substrate.

33. The microelectronic contact structure of Claim 32, wherein each of said column elements is connected at said base thereof to a terminal of said substrate, and further comprising a connector comprising a wire core joined to said terminal of said substrate, and connected to a second terminal of said substrate.

34. The microelectronic contact structure of Claim 1, wherein said contact element further comprises a plurality of beams, and wherein each of said plurality of beams is transverse to said column elements.

35. A substrate having a plurality of microelectronic spring structures mounted thereto, wherein each of said microelectronic spring structures comprises:

a group of column elements, wherein each column element has a top and a base, and is joined to said substrate at said base; and

a beam formed of a resilient material, and joined to each of said column elements in said group adjacent to said top thereof, whereby said beam is positioned transverse to each of said column elements.

36. The substrate of Claim 35, wherein said substrate comprises a probe card.

37. The substrate of Claim 35, wherein said substrate comprises a semiconductor material containing an integrated circuit.

38. The substrate of Claim 35, wherein said substrate comprises an interposer.

39. The substrate of Claim 35, wherein said substrate comprises a space transformer.

40. The substrate of Claim 35, wherein said substrate comprises an electrical connector.

41. A substrate-mounted microelectronic spring structure, comprising:

a substrate;

a substantially rigid column element having a top and a base, and joined at said base to said substrate, wherein said column element comprises a substantially straight segment of wire; and

a resilient cantilevered beam having a free end, and joined to said top of said column element at a joint a distance away from said free end;

wherein said microelectronic spring structure is configured such that said top of said column element is substantially fixed while said cantilever beam permits elastic deflection of said free end thereof under a force applied to said beam at said free end towards said substrate.

42. The microelectronic spring structure of Claim 41, wherein said column element is inclined to said beam at an angle between 70° and 110°.

43. The microelectronic spring structure of Claim 41, wherein said resilient cantilevered beam is sloped away from said substrate

44. The microelectronic spring structure of Claim 41, wherein said resilient cantilevered beam is contoured in a direction perpendicular to said substrate.

45. The microelectronic spring structure of Claim 41, wherein said resilient cantilevered beam is fabricated by a lithographic process that includes depositing said resilient material on a sacrificial substrate.

46. The microelectronic spring structure of Claim 41, further comprising a tip structure positioned on a surface of said beam opposite to said column element.

47. The microelectronic spring structure of Claim 41, wherein said tip structure is positioned adjacent to said free end of said beam.

48. The microelectronic spring structure of Claim 47, wherein said tip structure comprises a stand-off mounted to said beam, and a contact tip mounted to said stand-off.

49. The microelectronic spring structure of Claim 41, wherein said column element comprises a wire core enclosed in a shell comprising at least one shell material.

50. The microelectronic spring structure of Claim 49, wherein said shell is formed by plating said shell material onto said wire cores.

51. The microelectronic spring structure of Claim 49, wherein said wire core is ball-bonded to said substrate.

52. A method of making a microelectronic spring structure, comprising the steps of:

providing a plurality of column elements, wherein each column element has a base and a top;

joining each of the column elements to a substrate adjacent to the base thereof;

providing a beam component having a first end and a second end, wherein the beam component is a resilient elongate member; and

joining each of the column elements to a surface of the beam component adjacent to the top thereof.

53. The method according to Claim 52, further comprising providing a tip structure, and joining the tip structure to a surface of the beam component.

54. The method according to Claim 52, wherein said second providing step further comprises forming the beam component on a sacrificial substrate.

55. The method according to Claim 52, wherein said second providing step further comprises fabricating the beam component by a lithographic process that includes depositing a resilient material on a sacrificial substrate.

56. The method according to Claim 52, wherein said second joining step further comprises positioning the column elements in a group adjacent to the first end of the beam component.

57. The method according to Claim 56, further comprising providing a tip structure, and joining the tip structure to a surface of the beam component, wherein said joining a tip structure step further comprises positioning the tip structure adjacent to the second end of the beam component.

58. The method according to Claim 52, wherein said first providing step further comprises providing segments of wire, and forming each of the column elements from one of the segments of wire.

59. The method according to Claim 58, wherein said first joining step further comprises ball-bonding the wire segments to the substrate, and plating each of the wire segments with a shell material.

60. The method according to Claim 58, further comprising coating each of the segments of wire with a shell material.

61. A microelectronic spring structure, comprising:

substrate means for supporting a structure:

support means for supporting a beam, for securing a beam to said substrate means, and for elevating a beam above said substrate means; and

resilient beam means for contacting an electronic component, said resilient beam means supported by said support means.

62. The microelectronic spring structure of Claim 61, wherein said support means comprises a group of substantially rigid column elements.

63. The microelectronic spring structure of Claim 61, wherein said resilient beam means comprises a substantially straight beam of resilient material.

64. The microelectronic spring structure of Claim 61, wherein said resilient beam means comprises a beam of resilient material contoured in a direction perpendicular to said substrate.

65. The microelectronic spring structure of Claim 61, wherein each of said column elements of said group comprises a segment of wire.

66. The microelectronic spring structure of Claim 61, further comprising contact tip means for contacting a terminal of an electronic component, said contact tip means supported by and secured to said resilient beam means.

67. The microelectronic spring structure of Claim 66, wherein said contact tip means comprises a stand-off, and a contact tip mounted to said stand-off.